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LISTS OF SPECIES

Vascular plants, coastal dunes between Pehuen-có and Monte Hermoso, Buenos Aires, Argentina.

Cintia E. Celsi [1]
Ana L. Monserrat [1, 2]

[1] *Fundación de Historia Natural Félix de Azara, Departamento de Ciencias Naturales y Antropología, CEBBAD, Universidad Maimónides. Valentín Virasoro 732, C1405BDB. Ciudad Autónoma de Buenos Aires. República Argentina. E-mail:* cintiacelsi@gmail.com

[2] *Laboratorio de Geología Marina y Dinámica Costera, Departamento de Geología, Facultad de Ciencias Exactas y Naturales, Universidad de Buenos Aires. Ciudad Universitaria, Pabellón 2, EHA1428.*

Abstract: Buenos Aires coastal dune systems undergo an accelerated process of human induced modification, causing loss of native plant species and changes in species composition, cover and/or abundance. We present a species list of vascular plants recorded in a region of dune landscape between Pehuen-có and Monte Hermoso localities, southern Buenos Aires Atlantic coast. The area comprises fixed and active dune systems, frontal dunes, sandy marine beach and an abrasion platform. Vegetation sampling was performed using line-transects perpendicular to the coastline. Vascular plants were identified and species cover percentage was estimated in 10 m x 10 m plots. 31 families and 75 species were registered. Asteraceae, Poaceae, and Fabaceae were best represented. Ten exotic taxa were found. Vegetation structure is associated to geomorphologic heterogeneity. The site preserves rich flora with high number of native vascular plants. The presence of *Neosparton ephedroides* was verified. Conservation guidelines are necessary to protect the local biodiversity.

Introduction

Coastal dunes are highly fragile ecosystems, which have been historically subjected to different kinds of human activities. Non planned land use has led to an important loss of area, fragmentation and quality degradation of this kind of ecosystems worldwide. However, in the last decades the ecological value of the coastal dunes is being increasingly recognized, and land managers have started to implement diverse measures for the protection and restoration of dune habitats (Martinez et al. 2004).

Coastal dunes constitute particular environments. The ecological processes they support and the ecosystem services they provide hold special interest for conservation (Carter 1993). Among them we can mention that coastal dunes:

- are the natural habitat for the conservation of native species (endemic, threatened and migratory species, among others);
- shelter the coastline against marine erosive processes;
- contribute to the formation and maintenance of the aquifer;
- constitute valuable scenic and tourist attractions.

In Buenos Aires, dune systems were once the predominant coastal landscape, but they have not escaped from the effects of human actions and they currently undergo an accelerated process of modification. The main cause of observed human impact is the proliferation of activities derived from tourism without a proper planning: urban growth, afforestation with exotic species, roads construction, sand extraction, and non planned and invasive development of recreational activities, among others (Dadon 2002). All the mentioned activities cause the loss of native plant species as well as changes in species composition, cover and/or abundance.

Within this scenario, however, some natural areas of the original coastal dunes presenting a low degree of anthropogenic modification still remain along the Province (Celsi and Monserrat 2006; Monserrat and Celsi 2006). Although these remnants are becoming more and more limited, isolated and smaller, the biggest and best conserved ones are located in southern Buenos Aires Atlantic coastal zone. At this portion of the coast, human impact and land use pressure are less intense and the density of urban centers is lower than in the rest of the province's coast.

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Due to the importance of conserving the structure and functions of coastal dune ecosystems, investigations are being carried out by the authors aiming to identify areas of high ecological value for the conservation of coastal dune landscapes in Buenos Aires. One of the basic steps when planning the management of a natural area is to count on solid and complete baseline data about the local species composition. Few studies have attempted to describe the floristic composition of Buenos Aires coastal dunes (e.g. Cabrera 1941; Faggi and Cagnoni 1991; Pfadenhauer 1993; Faggi et al. 1997; Fontana 2005). In accordance to this, we present a species list of vascular plants recorded in an area of dune landscape of high conservation value and pristine characteristics, at southern Buenos Aires Atlantic coast.

Materials and methods

Study site

The study area lies between 38°59' S, 61°32' W and 38°59' S, 61°21' W. The area comprises a 16.5 km long coastal dune fringe, along southern Buenos Aires Atlantic coast. The village of Pehuen-có and the city of Monte Hermoso are located west and east of the study site, respectively (Figure 1). Both urban centers originated on the basis of beach tourism and their current economic development depends largely on tourist activities. A great number of visitors arrive in these localities throughout the summer months. Despite the associated human use on the natural ecosystem, the study area still does not show signs of substantial alterations and preserves the ecological structure of the original landscape.

The coastal landscape consists of fixed dunes (landwards), active dunes (adjacent to the coastline), frontal dunes (seawards), a sandy marine beach with superficial gravel and an abrasion platform temporally exposed at different sections of the beach.

The dune system reaches a width of 6.5 km from the beach towards the continent, showing dunes up to 10 m high. The beach is approximately 100 to 150 m wide (Marcomini et al. 2005). The beach fringe has recently been designated as "Geological, Paleontological and Archeological Reserve" by the provincial government, because it contains Holocene/Pleistocene fossils and archeological deposits in the abrasion platform (Aramayo and Manera de Bianco 1996).

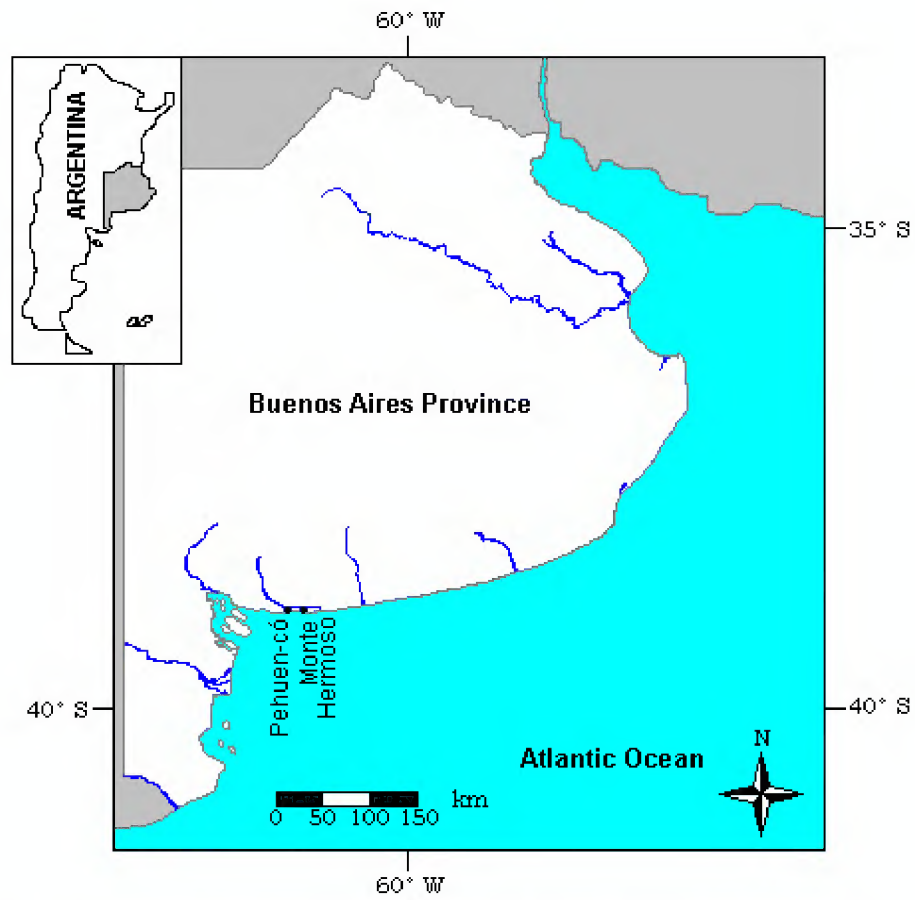

Figure 1. Map of the province of Buenos Aires. The study site is located between the village of Pehuen-có and the city of Monte Hermoso.

According to Cabrera (1971), the study site is located at the southern part of the "Pampeana" phytogeografic Province, within the "Pampeano Austral" District. The natural vegetation of the Province is dominated by the genus *Stipa*, though it has been strongly modified by agricultural use since 1970. Edaphic communities remain unaltered in some sectors such as the study area.

The regional climate is dry/sub-humid temperate. Mean annual temperature is 15.4 °C, reaching the maximum in January (monthly mean maximum: 25.6 °C) and the minimum in July (monthly mean minimum: 5.4 °C). Mean annual precipitation is 684.9 mm unevenly distributed along the year (Servicio Meteorológico Nacional 1991-2000)

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Data collection

Systematic vegetation sampling was carried out in December 2005, by means of 4 line-transects perpendicular to the coastline, averaging 550 m long, separated by 3.2 km (Figure 2). Every homogeneous unit of vegetation ("patch") detected by direct observation along the transects was sampled using a 10 m x 10 m plot. When the total vegetation cover was lower than 5 % and the spacing between individuals exceeded 10 m, the patch was sampled using a 20 m wide sweep-transect along the main line transect. The use of line transects and quadrate plots – sampling units- as an adequate procedure to sample vegetation in heterogeneous landscapes is discussed in Matteucci and Colma (1982).

For every plot, the geomorphologic position was registered following 5 categories:

- upper beach
- active frontal dunes
- fixed/semifixed dunes
- active inner dunes
- dune slacks

In every plot vascular plants were identified and the cover percentage was visually estimated for each species. Plant specimens were only collected for laboratory examination when species identification was not possible at the field. Data were complemented with vegetation surveys and field observations in summer and winter months in order to detect seasonal species.

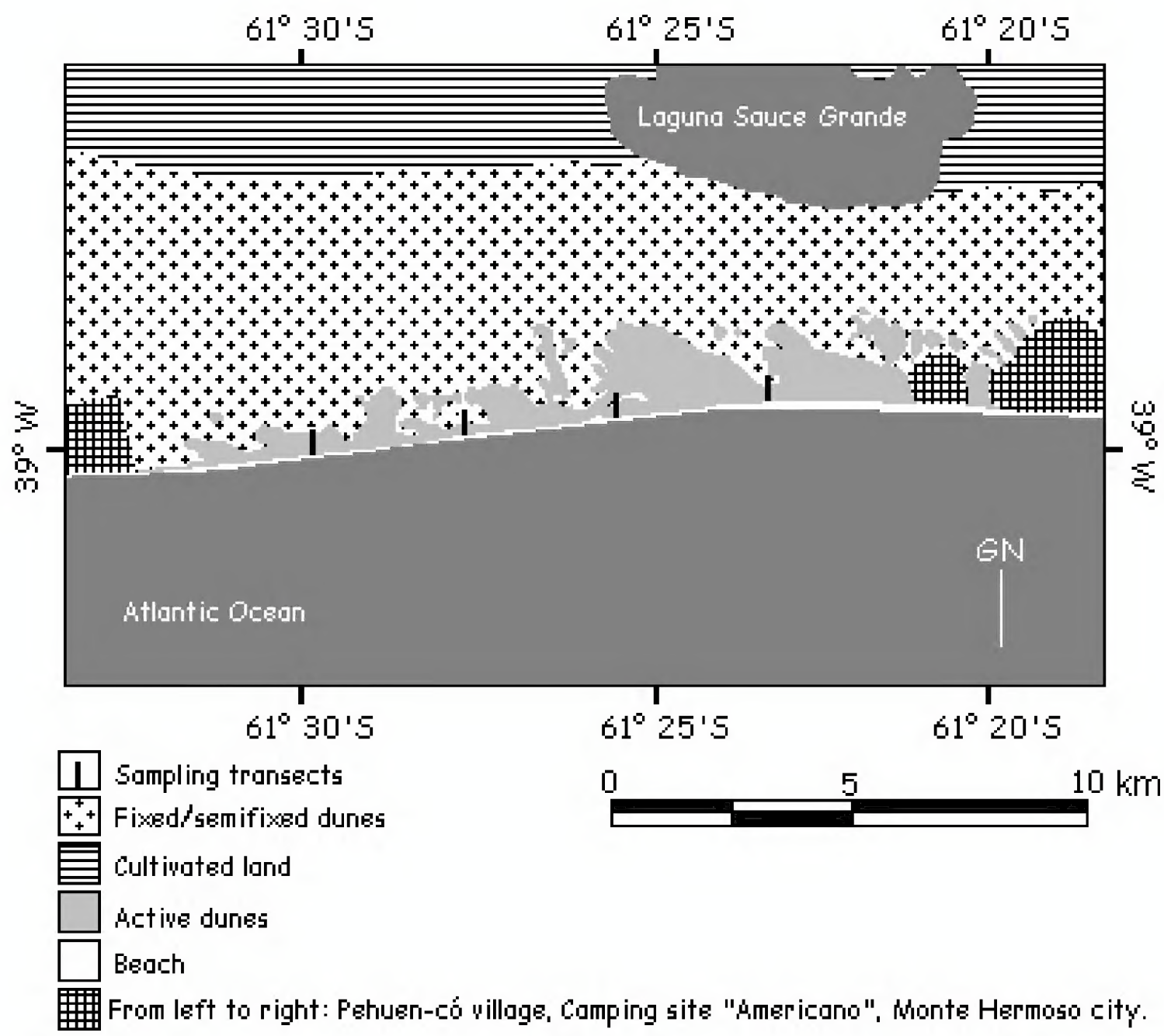

Figure 2. Zonation of the main landscape units and the position of the four sampling transects. Map based on Landsat satellite image provided by CONAE and field data.

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Data analysis

Species determination followed Cabrera (1963-1970). Nomenclature was updated according to Zuloaga and Morrone (1999).

For data collected in the systematic sampling, the mean cover percentage was calculated for each species at each geomorphologic location where it was present. The mean cover percentages were expressed as ranks following the scale below:

I : >0 % – 0.99 %
II : 1 % - 2.99 %
III : 3 % - 4.99 %
IV : 5 % - 14.99 %
V : 15 % - 24.99 %
VI : 25 % - 49.99 %
VII : 50 % - 74.99 %
VIII : 75 % - 100 %

Since low cover percentages were highly predominant in the total data set, the scale was elaborated in order to show greater discrimination among the lower values.

Taxa for which no cover data were available, are only indicated in the corresponding geomorphologic location as "present".

Results and discussion

41 sampling plots were registered. A total of 31 families and 75 species of vascular plants were registered (Table 1). Among them, 10 were exotic taxa. The families Asteraceae, Poaceae and Fabaceae were the best represented, which agrees with previous studies (Fontana 2005).

Table 1. Vascular plants recorded in the coastal dunes between Pehuen-có and Monte Hermoso, province of Buenos Aires. Species mean cover percentages at corresponding geomorphologic locations are expressed according to the scale presented in the text. ND: no cover percentage data is available, but the species was present in the corresponding geomorphologic location; (?): uncertain determinations; (*): exotic species.

		Geomorphologic location				
Family	**Species**	**upper beach**	**active frontal dunes**	**active inner dunes**	**fixed/ semifixed dunes**	**dune slacks**
Azollaceae	*Azolla filiculoides*	---	---	---	---	ND
	Achyrocline satureioides	---	---	---	**III**	**IV**
	Ambrosia tenuifolia	---	---	---	**II**	**II**
	Baccharis divaricata	---	---	---	**II**	---
	Baccharis juncea	---	---	---	---	ND
	Baccharis genistifolia	---	---	---	ND	---
	Baccharis salicifolia	---	---	---	ND	---
	Gamochaeta subfalcata (?)	---	---	---	ND	---
	Hyalis argentea	---	**I**	**I**	**V**	---
	Senecio madagascariensis (*)	---	---	---	**I**	**I**
Asteraceae	*Senecio vira-vira*	---	---	---	ND	---
	Senecio bergii	---	**I**	**I**	**II**	---
	Senecio pinnatus var. *pinnatus*	---	---	---	**I**	---
	Senecio subulatus var. *erectus*	---	---	---	**I**	---
	Senecio subulatus var. *subulatus*	---	---	---	**I**	---
	Solidago chilensis	---	---	**I**	**II**	**I**
	Stevia satureiifolia var. *patagonica*	---	---	---	ND	---
	Tessaria absinthioides	---	---	**I**	**III**	**I**
	Thelesperma megapotamicum	---	---	---	ND	---
	Xanthium cavanillesii	---	---	---	---	ND

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Table 1. Continued.

Family	Species	Geomorphologic location				
		upper beach	**active frontal dunes**	**active inner dunes**	**fixed/ semifixed dunes**	**dune slacks**
Poaceae	*Agrostis platensis*	---	---	---	**I**	**II**
	Aira caryophyllea	---	---	---	**I**	---
	Aristida spegazzinii	---	---	---	**II**	---
	Bromus sp. (*)	---	---	---	**I**	**I**
	Chascolytrum subaristatum	---	---	---	**ND**	---
	Cortaderia selloana	---	---	**I**	**IV**	**VI**
	Imperata brasiliensis	---	---	---	**II**	**VI**
	Melica sp.	---	---	---	**I**	---
	Panicum urvilleanum	**II**	**IV**	**III**	**II**	---
	Phragmites australis	---	---	---	---	ND
	Poa lanuginosa	**II**	**II**	---	**IV**	**II**
	Polypogon imberbis	---	---	---	**III**	**I**
	Schizachyrium spicatum	---	---	---	ND	---
	Spartina ciliata	**II**	---	---	---	---
	Sporobolus rigens	**II**	**II**	---	---	---
	Vulpia myuros	---	---	---	ND	---
Pinaceae	*Pinus* sp. (*)	---	---	**I**	---	---
Ephedraceae	*Ephedra ochreata*	---	---	---	**I**	---
Typhaceae	*Typha* sp.	---	---	---	---	**V**
Juncaceae	*Juncus acutus*	---	---	---	**I**	**IV**
	Juncus imbricatus (?)	---	---	---	---	ND
	Juncus microcephalus	---	---	---	---	ND
	Juncus micranthus	---	---	---	**I**	**III**
	Juncus tenuis var. *dichotomus*	---	---	---	**I**	**IV**
Iridaceae	*Sisyrinchium platense*	---	---	---	ND	---
Cyperaceae	*Schoenoplectus americanus*	---	---	---	**II**	**IV**
	Schoenoplectus californicus	---	---	---	---	ND
	Carex vixdentata	---	---	---	**I**	---
	Eleocharis macrostachya	---	---	---	**III**	**II**
Asclepiadaceae	*Asclepias mellodora*	---	---	---	ND	---
Boraginaceae	*Heliotropium curassavicum*	---	---	---	---	ND
Verbenaceae	*Neosparton ephedroides*	---	---	**I**	---	---
Solanaceae	*Solanum chenopodioides*	---	---	---	ND	---
Calyceraceae	*Calycera crassifolia*	**IV**	**III**	**I**	**I**	---
Myrtaceae	*Eucaliptus* sp. (*)	---	---	**I**	---	---
Tamaricaceae	*Tamarix gallica* (*)	---	---	**I**	---	---
Umbeliferae	*Hydrocotyle bonariensis*	---	**I**	---	**II**	**III**
Onagraceae	*Oenothera mollissima*	---	---	---	**I**	---

LISTS OF SPECIES

Table 1. Continued.

Family	Species	Geomorphologic location				
		upper beach	active frontal dunes	active inner dunes	fixed/ semifixed dunes	dune slacks
Fabaceae	*Adesmia filipes*	---	---	---	**II**	---
	Adesmia muricata	---	---	---	ND	---
	Glycyrrhiza astragalina	---	---	---	**IV**	**I**
	Medicago lupulina (*)	---	---	---	ND	---
	Melilotus albus (*)	---	---	---	**II**	**IV**
	Melilotus indicus (*)	---	---	---	---	**I**
Euphorbiaceae	*Euphorbia* sp.	---	---	---	ND	---
Anacardiaceae	*Schinus johnstonii*	---	---	---	**I**	---
Rosaceae	*Margyricarpus pinnatus*	---	---	---	**I**	---
Scrophulariaceae	*Agalinis genistifolia*	---	---	---	---	**II**
Rhamnaceae	*Discaria americana*	---	---	---	**III**	---
Plantaginaceae	*Plantago patagonica*	---	---	---	**I**	---
Hydnoraceae	*Prosopanche bonacinae*	---	ND	ND	---	---
Polygonaceae	*Polygonum* sp.	---	---	---	---	ND
Caryophyllaceae	*Silene antirrhina* (*)	---	---	---	**I**	---
Ranunculaceae	*Clematis montevidensis*	---	---	---	**I**	---
Brassicaceae	*Lepidium* sp.	---	---	---	ND	---
Gentianaceae	*Centaurium pulchellum* (*)	---	---	---	**I**	---

The presence of *Neosparton ephedroides* Griseb. (before, *N. darwinii* Benth. & Hook.) was verified. This record is especially significant for conservation since it constitutes the only population in the province of Buenos Aires. It has a restricted distribution comprising only 1,900 ha surrounding the village of Pehuen-có and was considered endemic (as *N. darwinii*) until recently (Zalba and Nebbia 1999).

As several authors have pointed out in various parts of the world, many dune ecosystems support high plant richness and diversity values (e.g. Musila et al 2001; Grootjans et al 2004; Fontana 2005). In this sense, the present work also indicates that the study area preserves a rich flora with high number of native vascular plants. Moreover, the different vegetation formations together with the dune field geomorphologic heterogeneity provide a wide variety of environmental conditions and habitat types that support a diverse native fauna.

Particular animal species depend on the different vegetation formations of the study area to survive. Among them, *Ctenomys australis* (dune rodent, Ctenomyidae) (Contreras and Reig 1965) and *Liolaemus multimaculatus* (dune lizard, Liolaemidae) (Kacoliris et al. 2006) are two regionally endemic species of the coastal dunes whose conservation is tightly tied to the protection of the environment they live in.

The conservation of the native vegetation of the studied area between Pehuen-có and Monte Hermoso constitutes a priority to keep the natural communities integrity. The preservation of their biotic interactions is critical for supporting the ecological structure and functions of Buenos Aires coastal landscape in the long term.

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Figure 3: *Neosparton ephedroides*; the only population of this species in the province of Buenos Aires is restricted to 1,900 ha surrounding Pehuen-có. A, shrub's general aspect; B, inflorescence.

Figure 4. *Senecio bergii*; frontal dune species.

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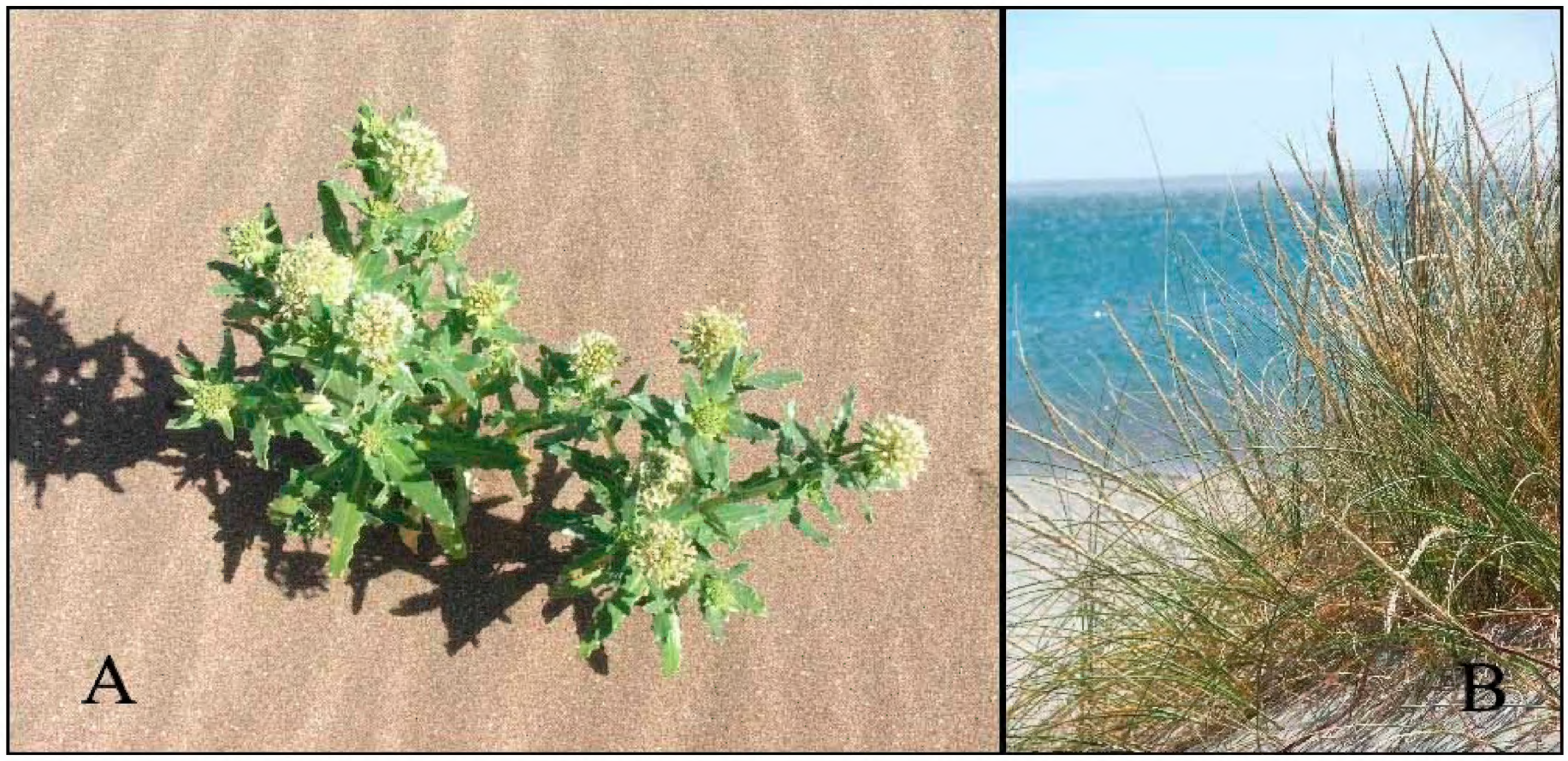

Figure 5. Two of the few species growing on the upper beach and active frontal dunes. A, *Calycera crassifolia*; B, *Sporobolus rigens*.

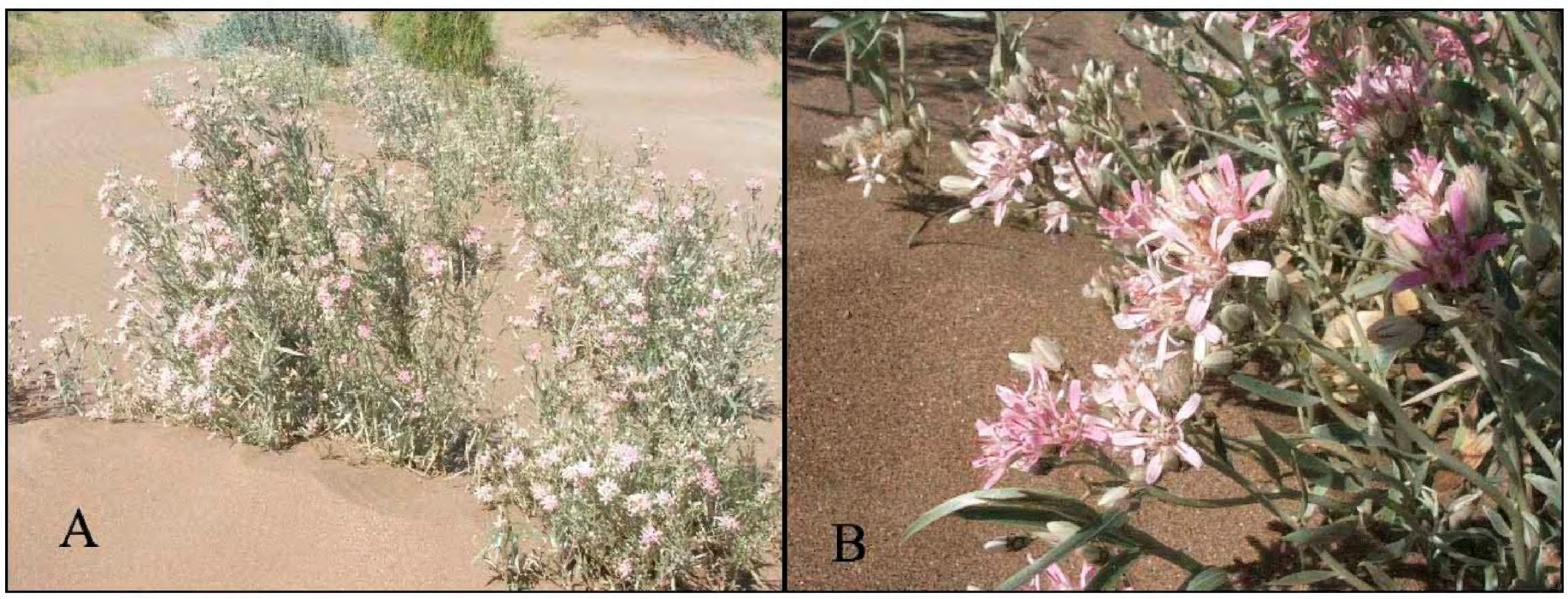

Figure 6. *Hyalis argentea*; One of the most abundant species on the fixed dunes. A, general aspect; B, inflorescences.

Figure 7. Typical species on the dune slacks; A, *Cortaderia selloana*; B, *Typha* sp.; C, *Schoenoplectus californicus* growing in an interdunal lake.

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Figure 8. Plants of the fixed dunes; A, Xerophitic shrub *Schinus johnstonii*; B, Annual herb *Plantago patagonica*; C, Native Gymnosperm *Ephedra ochreata*; D, Perennial herb *Oenothera mollissima*.

Figure 9. General aspect of the frontal dunes between Pehuen-có and Monte Hermoso with a winter cover of *Panicum urvilleanum* and *Poa lanuginosa*.

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